Investigating Consumer Preference for Biodegradable Containers[1]

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Abstract

Instead of virgin plastic, some growers are now using containers manufactured with alternative materials that can be planted directly in the soil and will degrade over time, thus eliminating the waste of disposing the pot into landfills. While previous studies have addressed certain aspects of consumer willingness to pay issue for biodegradable containers, this study specifically addresses consumer's perceived value for the containers themselves; that is, without the influence of the plant in the container. Analysis of the confidence intervals for wheat starch pots, rice hull pots, straw pots, coir pots, and peat pots reveal that they are overlapped, which indicates the price premiums participants are willing to pay for these five types of biodegradable containers do not significantly differ from each other. Consumers express a positive willingness to pay for several types of biodegradable containers relative to the standard virgin plastic container. There are two distinct levels or tiers that emerged with the first tier including coconut coir and peat pots, which received ratings in the same range as rice hull, straw, and wheat pots. A second, lower tier of similarly rated containers included the poultry feather, cow manure, and recycled plastic pots (relative to virgin plastic).

Index words: marketing, willingness to pay, biodegradable pots.

Significance to the Nursery Industry

Most nursery plants are sold in some type of container, with the exception of bare-root plants. Many of these containers are manufactured from plastic. Through intelligent packaging and system design, it is possible to 'design out' the potential negative impact of ornamental plant packaging on the environment and society — in this case, the prominent amount of virgin plastic produced as requisite to the nursery and greenhouse industry. 'Cradle to cradle' principles offer strategies to improve the material health of packaging and close the loop on packaging materials including the creation of economically viable recovery systems that effectively eliminate waste. The use of biodegradable pots reflects these cradle to cradle principles. This research has the potential to benefit the nursery and floral consumers by ensuring that environmentally-friendly products are available for their use while contributing to green industry sustainability.

Introduction

The vast majority of greenhouse and nursery crops produced today are grown in plastic containers. Botts (2) reported that making nursery pots, flats and cell packs uses 160 K tons (145.2 M tons) of plastic annually. Consumer demand for product-stewardship or environmentally-conscious products and business practices is rapidly rising. In 2007, an

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e-Marketing article reported that 9 of 10 participants perceived themselves as environmentally responsible (1). Even mass-merchants like Walmart recognize that 'being green' not only provides value to consumers but has the potential to positively impact profits (7).

Today, more than 75% of nursery and greenhouse containers have a recycle code on the bottom of the container. In addition, recycled ornamental plant containers can be sanitized for re-use for production of subsequent crops. Other uses also exist for recycled plastic pots. For example, Eco-Quest in Grand Haven, MI, processes a small volume of nursery containers into pieces that are used to manufacture landscape timbers or new battery cases (5).

In the future, horticultural companies may offer consumers a choice of recycling their plant containers or to purchase biodegradable containers. In response to anticipated consumer demand for more environmentally-friendly horticultural containers, several companies are currently marketing alternatives to plastic. Examples of these include containers made of rice hulls, straw, corn or wheat starch, poultry feathers, peat moss, bamboo pulp, dairy manure fiber, and coconut coir. Robinson (9) reported that most biodegradable containers cost 10 to 40% more than their plastic counterparts.

Each of the aforementioned material has a different rate of degradation, but is more environmentally-friendly than discarding plastic containers. Some greenhouse producers are experimenting with growing plants in these containers and there is increased interest on the part of lawn and garden retailers (e.g. large box stores like Walmart, Lowe's, and Home Depot). Some growers are concerned about consumer response and wonder whether biodegradable containers will be readily accepted or whether they should pursue recycling strategies. Consumers are not homogeneous in their preferences, attitudes, and purchases. Thus, there are likely groups of consumers who will respond more favorably to these alternative containers.

Recycling plastic containers raises a different set of concerns. Will it cost more to have plastic removed from the site or is it more cost effective to sanitize and reuse plastic containers? Some nursery growers have concerns about reusing recycled plastic containers for fear that disease outbreaks will be higher and worry that sanitizing them may not render them 'clean' enough to be used for production again.

Horticultural businesses may be perplexed with regard to a sustainable strategy that would be best for their businesses and most readily adopted by their customers. What types of biodegradable containers do consumers prefer? Which consumers are more eager to adopt alternative types of biodegradable containers? Which production and marketing strategies (e.g. reuse plastic containers or offer biodegradable containers) are better for greenhouse, nursery, and landscape professionals? Our objective was to find answers to the aforementioned questions.

Material and Methods

To address the issue of willingness to pay (WTP) for biodegradable containers, research was conducted using a combination of: (1) a hypothetical conjoint analysis using pictures of plants in biodegradable pots (4" chrysanthemums) and (2) a sealed-bid experimental auction using real plants in biodegradable pots to elicit consumer WTP for selected biodegradable containers including those made from rice hulls, straw, and wheat starch (OP-47). Selected results of the conjoint analysis and experimental auction analysis have been reported on previously (3, 10).

A third part of the study examined consumer reactions to the biodegradable pots themselves, without any plant material presented to influence their reaction, and also included other biodegradable pot types including those made from peat, coconut coir, poultry feathers, cow manure, and recycled plastic. It is this part of the study that is reported on in this paper.

This portion of the analysis was conducted using an Internet survey developed by the researchers and implemented by Knowledge Networks during July 2009, who was utilized specifically on this project due to their web-enabled KnowledgePanel®, a probability-based consumer panel designed to be representative of the U.S. population.

All KnowledgePanel households have a known probability of selection. Initially, participants are chosen scientifically by a random selection of telephone numbers or addresses (using address-based sampling). Persons in selected households are then invited by telephone and mail to participate in the web-enabled panel. Even though 69.6% of the U.S. population has internet at work or home (4), Knowledge Networks provides internet access to potential respondents that are without it, thereby eliminating that potential source of bias. People who already have computers and internet service are permitted to participate using their own equipment. Panelists then receive unique log-in information for accessing surveys online, and then are sent emails three to four times during the survey time frame inviting them to participate in research. Advantages of Web-based surveys according to McCullough (6) are that they are potentially faster to conduct than telephone or face-to-face interviews, generate more accurate information with less human error.

In the survey, we asked what types and amounts of plants participants have purchased, at what types of stores they often made the purchases, how much money they have spent on plants and gardening supplies, recycling behaviors of retailers where participants have purchased most plants, participants' own personal and household recycling behaviors, and the willingness to pay (WTP) questions. We asked the WTP questions because price has been shown to be a critical factor in a consumer's buying decision. Even though our main objective was to compare consumer preferences for biodegradable versus traditional containers, price is essential given that many customers exhibit a tendency to purchase ordinary products with lower 'environmental quality' because of cost and performance considerations or ignorance and disbelief (8).

The WTP questions included eight types of pots in pictures with the raw materials comprising each pot clearly labeled. The eight alternatives included pots made from recycled plastic, wheat-starch, rice hulls, straw, coconut coir, the resin from poultry feathers, cow manure and peat moss. Each WTP question stated: 'In the following questions, please identify how much more or less you are willing-to-pay for the potting container form compared to a plastic potting container.' Survey participants were then asked to select one answer from –$1.50 to $1.50, with increments of $0.50 (Fig. 1).

In order to eliminate respondents who did not purchase outdoor plants, we asked potential respondents if they had purchased any plants for any type of outdoor use during the last year (since July 2008). If the respondent did not purchase

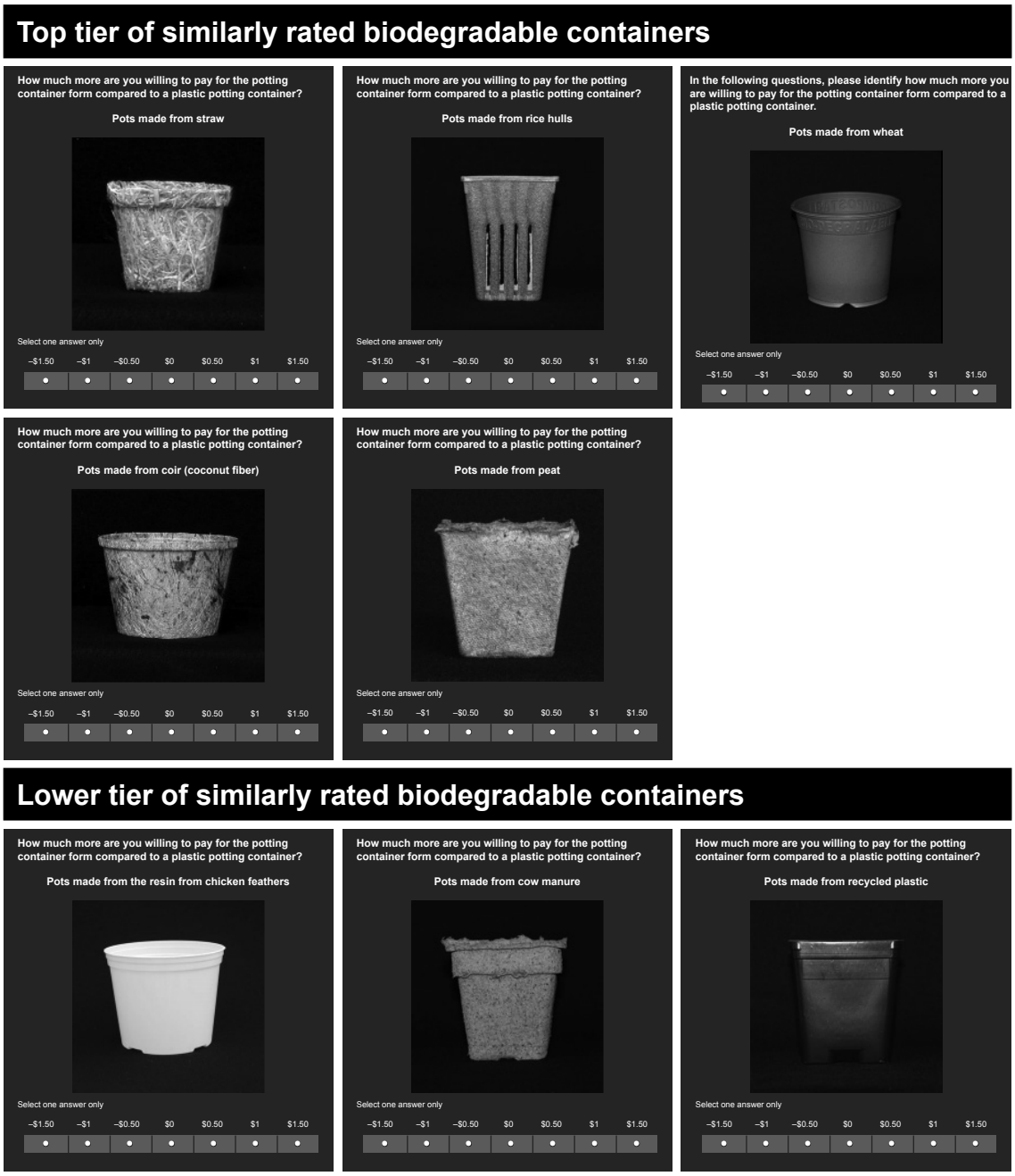

Fig. 1. Stated preference questions soliciting consumer willingness to pay ratings for containers not included in the conjoint analysis or experimental auction portion of the study with virgin plastic pots used as the base comparison. Only the pot itself was evaluated versus the pot and plant combination in the other portions of the study.

any plants, then the survey ended and the respondent did not proceed to subsequent questions. An answer of 'yes' allowed the respondent to finish the rest of the survey. A total of 1,113 participated in the survey with 834 participants completing the survey. The remainder of the respondents did not finish the survey since they did not purchase any ornamental plants in the past year.

Econometric model. We used a random individual effect two limit tobit model to estimate the survey data. For the dependent variable, the underlying model is

$$y^* = X\beta + u + e \quad (1)$$

where y^* is a continuous latent variable, X is a matrix of explanatory variables, β is a vector of coefficients to be estimated, u is a vector of normally distributed random coefficients with variance σ_u^2, e is a vector of normally distributed error terms with variance σ_e^2. If we denote the observed dependent variable as y, then

$$\begin{aligned} y &= -1.5 \text{ if } y^* \le -1.5 \\ y &= y^* \text{ if } -1.5 \le y^* < 1.5 \\ y &= 1.5 \text{ if } y^* \ge 1.5 \end{aligned} \quad (2)$$

Table 1. Summary statistics of socio-demographic background information associated with participants in a 2009 survey of sustainable behaviors, attitudes, and preferences.[z]

Variable	Variable description	Mean	Std. dev.
Gender	Participant's gender was female, 1 = yes, 0 = no	0.52	0.50
Age	Participant's age	47.22	16.57
Education	Education was reported by 1 to 4 with four levels: 1 = less than high school 2 = High school 3 = Some college 4 = Bachelors degree or higher	2.70	0.92
Household size	Number of people in the household	2.69	1.39
Household income	Household income was summarized into 8 categories: 1=$15,000 or less 2= $15,001-$25,000 3=$25,001-$35,000 4=$35,001-$50,000 5=$50,001-$65,000 6=$65,001-$80,000 7=$80,001-$100,000 8=over $100,000	4.60	2.18
House type	Participant lived in a house, 0 = yes, 1 = no	0.16	0.37

[z]The population was consumers who have purchased plants from four states: Indiana, Michigan, Minnesota and Texas. The survey sample size was 1,113, of which there was 834 valid responses. The rest was not included in the analysis since they had not purchased plants in the past year.

The model is one of a censored dependent variable because observations at the limits are observed. We used a random individual effect two limit tobit model instead of standard two limit tobit model because each individual evaluated multiple products and it's very likely that the multiple evaluations from the same participants were correlated. The random individual effect is designed to capture the possible correlation. The data was estimated using software STATA 10.0.

Results and Discussions

Table 1 shows the summary statistics of survey participants' socio-demographic background information. Fifty-two percent of the participants were female; the average age of participants was 47 years old; the average education level was 'some college'; the average household income was approximately $50,000; and 84% of the participants lived in a single-dwelling residence and the remainder (16%) lived in another type of dwelling (e.g. apartment, mobile home, etc.).

Table 2. Results of the estimation of the price premium associated with selected biodegradable plant containers results using a random individual effect two limit tobit model.[z]

Variables	Coefficients	Std. err.	Confidence intervals
Intercept	0.092***[y]	0.022	(0.049, 0.136)
Wheat	0.195***	0.022	(0.153, 0.238)
Rice	0.151***	0.022	(0.109, 0.194)
Straw	0.137***	0.022	(0.094, 0.179)
Chicken feather	–0.011	0.022	(–0.054, 0.031)
Cow manure	0.004	0.022	(–0.039, 0.046)
Coir	0.144***	0.022	(0.102, 0.186)
Peat	0.152***	0.022	(0.110, 0.195)
σ_u	0.460***	0.013	(0.434, 0.485)
σ_e	0.434***	0.004	(0.426, 0.443)

[z]The population was consumers who have purchased plants from four states: Indiana, Michigan, Minnesota and Texas. The survey sample size was 1,113, of which there was 834 valid responses. The rest was not included in the analysis since they had not purchased plants in the past year.

[y]*** significant at the 1% level; ** significant at the 5% level and * significant at 10% level.

The estimation results from the random effect two limit tobit model are shown in Table 2. The variable for recycled plastic pots was dropped (the associated coefficients are set to zero) and used as the base for estimation. Therefore, the coefficients can be explained as the price premium participants were willing to pay for pots as compared with recycled plastic pots. The intercept is the price premium participants were willing to pay for recycled plastic pots compared with virgin plastic pots and the price premium was 9.2 cents on average.

Relative to recycled plastic pots, participants were willing to pay a statistically significant higher premium for pots made from wheat starch, rice hulls, straw, coir and peat. But participants' WTP for pots made from the resin from chicken feathers and pots made from cow manure were not significantly different from their WTP for recycled plastic pots.

As for the price premiums compared with recycled plastic pots, participants were willing to pay 19.5 cents more for pots made from wheat starch, 15.1 cents more for pots made from rice hulls, 13.7 cents more for pots made from straw, 14.4 cents more for pots made from coir, and 15.2 cents more for pots made from peat. The price premiums compared with virgin plastic pots were the aforementioned premiums plus the 9.2 cents (the price premium for recycled plastic pots relative to virgin plastic pots). Therefore, compared with virgin plastic pots, participants were willing to pay 28.7 cents more for pots made from wheat starch, 24.2 cents more for pots made from rice hulls, 22.9 cents more for pots made from straw, 23.6 cents more for pots made from coir and 24.4 cents more for pots made from peat.

It should be noted that these WTP estimates are lower than those reported for either the conjoint analysis or experimental

Table 3. Results of the estimation of the price premium associated with selected biodegradable plant containers results using a random individual effect two limit tobit model by including socio-demographic variables.[z]

Variables	Coefficients	Std. err.	Confidence intervals
Intercept	0.092	0.022	(0.049, 0.136)
Wheat	0.195***[y]	0.022	(0.153, 0.238)
Rice	0.151***	0.022	(0.109, 0.194)
Straw	0.137***	0.022	(0.094, 0.179)
Chicken feather	–0.011	0.022	(–0.054, 0.031)
Cow manure	0.004	0.022	(–0.038, 0.046)
Coir	0.144***	0.022	(0.102, 0.186)
Peat	0.152***	0.022	(0.110, 0.195)
Gender	0.036**	0.017	(0.002, 0.069)
Age	–0.008	0.020	(–0.048, 0.031)
Education	0.011	0.018	(–0.025, 0.047)
Household size	–0.020	0.020	(–0.059, 0.019)
Household income	0.002	0.019	(–0.036, 0.041)
House type	0.000	0.019	(–0.037, 0.037)
σ_u	0.458***	0.013	(0.432, 0.483)
σ_e	0.434***	0.004	(0.426, 0.443)

[z]The population was consumers who have purchased plants from four states: Indiana, Michigan, Minnesota and Texas. The survey sample size was 1,113, of which there was 834 valid responses. The rest was not included in the analysis since they had not purchased plants in the past year.

[y]*** significant at the 1% level; ** significant at the 5% level and * significant at 10% level.

auction portion of the study because these estimates represent consumer perceptions of the value of the biodegradable pots themselves, without any plant material present to influence their perceived value. Obviously, a flowering plant in the pots would increase the perceived value of the different pots in different ways and has been shown to do so (3, 10).

The last column of Table 2 shows the confidence intervals of the price premium relative to recycled plastic pots. The confidence intervals for wheat starch pots, rice hull pots, straw pots, coir pots, peat pots are overlapped, which indicates the price premiums participants are willing to pay for these five types of biodegradable pots do not significantly differ from each other. From the results we can see that consumers did express or state a positive willingness to pay for several types of biodegradable containers relative to the standard virgin plastic pot. There were two distinct levels or tiers that were evidenced as shown in Fig. 1, with the first including coconut coir and peat pots, which received ratings on the same level as rice hull, straw, and wheat pots.

A second, lower tier of similarly-rated pots included the poultry feather, cow manure, and recycled plastic pots (relative to virgin plastic). The stated price premiums expressed by consumers for the lower-tiered pots were all in the range of $0.10 per pot. The premium associated with the first tier of biodegradable containers aforementioned was about 2.5 to 3 times the lower level tier, depending on the container type. We also estimated the model by including participants' socio-demographic variables. Table 3 shows that the estimation results were very similar to those without including the socio-demographic variables. The only significant variable that affected participants' WTP was participants' gender. Female participants were willing to pay more for those aforementioned pots compared with virgin plastic pots than male participants.

The correlation among the multiple valuations from the same participants were statistically significant and cannot be ignored. Ignoring the correlation might lead to biased estimation results. Therefore, the random individual effect two limit tobit model rather than standard two limit tobit model should be used to estimate the data.

The research findings from this project are important in terms of providing guidelines relative to future merchandising strategies for biodegradable containers by industry firms. Green industry businesses need to be consistent with their message regarding these, and other, environmentally-friendly products (biodegradable and otherwise). Additionally, the value proposition of biodegradable products has to be clear and devoid of greenwashing (the misrepresentation of product attributes). They must perform as well or better than less environmentally-friendly products. Lastly, understanding why customers are buying green products and the premiums they are willing to pay for more sustainable options will influence pricing strategies for industry firms. If the point of differentiation of biodegradable containers can be successfully communicated to end users (making the demand for these products more inelastic), total revenue for industry firms will increase via any price premiums, even if total units sold decreases.

As a secondary benefit of this research, container manufacturers and distributors (as well as growers, landscape service providers, and retailers) now have a better understanding of the WTP of consumers to which they market products. Most businesses lack the resources and ability to conduct this type of research on their own, thus the study has provided consumer insight they would not have access to otherwise. Additionally, visibility of containers made from non-virgin plastic continues to increase. At a minimum, the study helps to improve awareness among consumers and industry professionals with regard to the number and type of alternative container materials available on the market today or coming to the market in the near future.

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